Suicidality Risk and (Repeat) Disaster Exposure: Findings From a Nationally Representative Population Survey

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Objective: Despite growing awareness of adverse mental health consequences, the scarce existing evidence on the link of disaster exposure and suicidality has remained inconclusive, and the differential suicidality risk associated with distinct levels of natural and man-made disaster exposure is unknown. We therefore investigated the lifetime prevalence and risk of suicidal behavior associated with natural and man-made disaster exposure in Australia. Method: We utilized data from a nationally representative mental health survey (n = 8,841). Univariate and multivariate logistic regression analyses examined the lifetime risk of suicidal thoughts, plans, and attempts associated with varied types and levels of disaster exposure. We focused explicitly on natural and man-made disasters while controlling for other types of trauma exposure, including established risk factors for suicidality. Results: Multivariate analyses indicated that those exposed to multiple natural (adjusted odds ratio [AOR] = 2.21, 95% confidence interval [CI] = [1.04, 4.71], $p < .05$) or man-made disasters (AOR 3.4, 95% CI = [1.20, 9.58] $p < .05$) were at significantly greater risk of making suicide attempts, whereas single natural or man-made disaster exposure was not associated with an increased risk of suicidal behavior. Conclusions: Our study findings establish the differential suicidality risk associated with natural and man-made disaster exposure in Australia and highlight the critical role of repeat disaster exposure across distinct disaster types. Suicidal behavior may warrant

increasing attention in psychosocial recovery schemes, particularly in the context of disaster-prone areas and for population groups at elevated risk of repeat disaster exposure.

Natural and man-made disasters represent globally increasing public health concerns that can have a significant impact on the mental health of affected populations (Norris et al., 2002). While the nature and extent of the adverse mental health consequences of disasters have been increasingly well documented over recent decades (Bonde et al., 2016; Galea, Nandi, & Vlahov, 2005; Yzermans, Van Der Berg, & Dirkzwager, 2009), the scarce existing evidence on the impact of such disaster events on population suicidality has remained largely inconclusive to date; it also has been the subject of considerable debate. Systematic reviews of epidemiological research on suicide in disaster contexts, which have primarily focused on natural disasters, have established considerable variability in the direction of suicide mortality trends among varied study populations (Kõlves, Kõlves, & De Leo, 2013; Rezaeian, 2008). Lacking comparability of findings from event-specific studies focusing on disasters of varying types and scale is often further compounded by methodological differences in study design (involving varied control groups or time periods) and by the existence of confounding factors, such as broader cultural factors or economic trends, which can impact on suicide trends (Rezaeian, 2008). Trends in suicide mortality rates in natural disaster contexts have therefore variously been found to point upward (Basagana et al., 2011; He, 1997; Nicholls, Butler, & Hanigan, 2006; Yip, 2009) or downward (Shioiri, Nishimura, Nushida, Tatsuno, & Tang, 1999; Shoaf, Sauter, Bourque, Giangreco, & Weiss, 2004), or to remain largely unchanged (Krug et al., 1999; Rodrigo, McQuillin, & Pimm, 2009). The overall picture regarding the research evidence on nonfatal suicidal behavior in natural disaster contexts is slightly less varied. A recent systematic review (Kõlves et al., 2013) identified a tendency toward an initial drop in suicidal behavior in the immediate postdisaster period (Kessler, Galea, Jones, & Parker, 2006; Yu et al., 2010). Other studies identified a delayed increase in suicidality further down the track (Chou et al., 2007; Kessler et al., 2008).

Despite the lack of systematic reviews of suicide research in man-made disaster contexts, the relatively few existing studies, which mainly investigated suicide trends in relation to the September 11, 2001, terrorist attacks in the United States, indicated no significant changes in overall suicide mortality rates (Mezuk et al., 2009; Pridemore, Trahan, & Chamlin, 2009) and only shortlived initial increases (De Lange & Neeleman, 2004) or decreases (Salib, 2003) in post-9/11 suicide rates overseas. Studies investigating nonfatal suicidal behavior following 9/11 have shown increases in suicide attempts requiring medical admission (Starkman, 2006) and longer-term suicidal ideation in primary care (Neria et al., 2013), while also identifying an immediate but short-lived decrease in suicide attempts abroad (Detsky, Sivilotti, Kopp, Austin, & Juurlink, 2005).

Risk factors for suicidality investigated in disaster contexts thus far are largely the same as those examined in the general population and include, among others, female sex, younger age, lower education and income, unmarried status, unemployment, and previous or existing mental disorders (Borges et al., 2010; Johnston, Pirkis, & Burgess, 2009), as well as varied adversities which are typically encountered in disaster contexts, such as physical injury or property damage (Kõlves et al., 2013).

Despite the increasing global significance and societal impacts of disasters, representative national data on the prevalence and risk of suicidality associated with natural and man-made disaster exposure is lacking. Moreover, while man-made disasters have frequently been shown to have more adverse mental health consequences than natural disasters (Norris & Elrod, 2006), little is known about the differential suicidality risk associated with varying levels of exposure to distinct disaster types. This knowledge gap, in turn, poses a significant barrier to effective disaster mental health response planning andto identifying and optimally assisting those who are likely to be most at risk in the wake of disaster.

The current study therefore drew on data from a nationally representative population survey to examine the prevalence of disaster exposure and differential suicidality risk associated with distinct types and levels of disaster exposure in Australia.

METHOD

Setting

Australia's disaster risk profile includes a range of natural and man-made hazards. Natural hazards, which are also common to other world regions, include floods, bushfires, cyclones, severe storms, droughts, heatwaves, and, to a lesser extent, earthquakes and tsunamis. The most recent *World Risk Report* rated Australia at a "high" risk of natural hazards exposure, similar to New Zealand, and above the "medium" risk encountered in the United States and the "low" to "very low" risk in many European countries (Welle & Birkmann, 2016). Simultaneously, Australia is subject to a wide range of man-made hazards, which include technological accidents, such as fires, explosions, and structural collapses; chemical, biological, and radiological hazards; transport accidents; mass shootings; and acts of terrorism. All of these have been encountered by Australians both at home and overseas. Recent comparative estimates of the likelihood of man-made disaster exposure in Australia placed the country at a slightly lower risk than the United States and several Western European countries (Benjet et al., 2016).

Sample

We utilized data from a nationally representative Australian population survey, the National Survey of Mental Health and Wellbeing (NSMHWB), which was conducted by the Australian Bureau of Statistics (ABS) in 2007 (Australian Bureau of Statistics, 2009). This cross-sectional survey employed randomstratified, multistage area probability sampling of persons ages 16 to 85 years old who were the usual residents of private dwellings to derive a nationally representative sample. A total of 8,841 respondents completed the full survey, representing an overall response rate of 60%, and a total target population of 16,015,345 adult Australians (Slade, Johnston, Oakley Browne, Andrews, & Whiteford, 2009).

Survey Instrument

The Composite International Diagnostic Interview, Version 3.0, of the World Health Organization's World Mental Health Survey Initiative (WMH-CIDI 3.0) (Kessler & Ustün, 2004) was utilized to assess key variables of relevance to this study, including (a) lifetime prevalence of suicidal thoughts, suicide plans, and suicide attempts; (b) lifetime exposure to potentially traumatic events (including natural and man-made disasters); and (c) sociodemographic characteristics (i.e., age, gender, country of birth, marital status, qualification, labor force status, relative socioeconomic disadvantage, and

household location). The WMH-CIDI 3.0 assessed the type and level (or frequency) of lifetime disaster exposure by way of asking all survey respondents two questions: "Were you ever involved in a major natural disaster, like a devastating flood, cyclone, or earthquake?" and "Were you ever in a man-made disaster, like a fire started by a cigarette, or a bomb explosion?" Participants were then asked "How many times (did that happen in your life)?" for each of those events.

Outcome Variables

Our key outcome variables were three binary variables representing the presence (coded *Yes* = 1) or absence (coded *No* = 0) of lifetime suicidal thoughts, plans, and attempts. The lifetime presence or absence of these experiences was assessed by asking all survey respondents whether any of the experiences referred to in the following statements had ever happened to them: "You seriously thought about committing suicide" (lifetime suicidal thoughts); "You made a plan for committing suicide" (lifetime suicide plans); and "You attempted suicide" (lifetime suicide attempts).

Exposure Variables

Our exposure variables included two binary variables representing the type of disaster to which the respondents had been exposed: man-made (coded *Yes* = 1 or *No* = 0) and natural (also coded *Yes* = 1 or *No* = 0). In addition, two categorical variables represented the level (or frequency) of respondents' exposure to each respective disaster type over their lifetime: man-made (coded *0, 1, 2 or more*) and natural (coded *0, 1, 2 or more*). We refer to the former binary variables as "types" of disaster exposure and to the latter categorical variables as "levels" of disaster exposure. This coding meant that we could identify respondents who had not been exposed to any disasters, those who had experienced one disaster, and those who had experienced two or more disasters of each respective disaster type.

Other Risk Factors

To control for exposure to other types of traumatic life events, we created a binary variable, exposure to any other type of traumatic event, which reflected either the presence (coded *Yes* = 1) or absence (coded *No* = 0) of respondent lifetime exposure to at least one of 27 "other" potentially traumatic events that are routinely assessed within the WMH-CIDI 3.0, irrespective of man-made or natural disaster exposure (Benjet et al., 2016; Mills et al., 2011). In addition, a categorical variable was created to control for levels of exposure to other types of traumatic events (coded as *0, 1, 2 or more*), irrespective of natural or man-made disaster exposure.

Other suicidality risk factors considered in this study included any lifetime *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition (*DSM*-IV), mental disorder (without diagnostic hierarchy rule applied); any lifetime *DSM*-IV affective disorder (without hierarchy); any lifetime *DSM*IV substance use disorder (including substance abuse and/or dependence, without hierarchy); lifetime *DSM*-IV alcohol use disorder (including alcohol abuse and/or dependence); and lifetime *DSM*-IV posttraumatic stress disorder. Each variable was coded *Yes* = 1 and *No* = 0 to indicate the presence or absence of respective lifetime disorders.

Analyses

We performed descriptive analyses to estimate the lifetime prevalence of disaster exposure in the Australian population. Univariate and multivariate logistic regression analyses were used to examine the differential lifetime risk of suicidality (i.e., suicidal

thoughts, plans, and attempts) associated with various types and levels of disaster exposure.

Univariate regression analyses initially explored the risk of lifetime suicidal thoughts, plans, and attempts (in terms of the three binary outcome variables) associated with respective types and levels of natural or man-made disaster exposure, with results presented as crude odds ratios (ORs). Multivariate regression analyses (Model 1) first examined the risk of lifetime suicidal thoughts, plans, and attempts associated with different types of disaster exposure (i.e., natural or man-made). These analyses controlled for both types of disaster exposure, all relevant sociodemographic variables listed previously, and exposure to any other traumatic event.

Subsequent multivariate regression analyses (Model 2) examined the differential risk of lifetime suicidal thoughts, plans, and attempts associated with varying levels of natural or man-made disaster exposure. These analyses controlled for respective levels of natural and man-made disaster exposure, sociodemographic variables, and exposure to any other traumatic event. Results of all multivariate analyses are presented as adjusted odd ratios (AORs).

Additional univariate analyses were carried out to examine possible underpinning differences in the likelihood of other suicidality risk factors among those exposed to 1 or "2 or more" disasters (of each disaster type). These risk factors included each of the previously noted lifetime *DSM*-IV mental disorder categories and "exposure to any other type of traumatic event." For these additional regression analyses, respective disaster exposure base levels were set to 1 (instead of 0) to explore differences between those exposed to 1 and "2 or more" disaster events.

Finally, we tested if there was effect modification between labor force status, relative socioeconomic disadvantage, and household location and our disaster exposure measures. We did this by testing a series of models where we fit an interaction between each potential modification variable and the disaster exposure variable. For example, one model tested an interaction between labor force status and exposure to natural disasters. In all, we fit 18 different models to the data, representing the three potential modification variables (labor force status relative socioeconomic disadvantage and household location), the two disaster exposure variables (natural and man-made), and the three outcome variables (lifetime suicidal thoughts, plans, and attempts). We assessed the strength of the evidence for these interactions using the joint Wald test.

All prevalence estimates and measures of association were weighted to conform to independent population estimates of national census data. This involved the application of 60 ABS-provided person-level replicate weights to account for the inverse probability of an individual being sampled and differential response patterns in the population. Standard errors for population estimates were calculated using the delete-a-group jackknife variance technique. All analyses were undertaken using STATA 13.1 (StataCorp, College Station, TX).

RESULTS

Lifetime Prevalence and Frequency of Disaster Exposure

Descriptive analyses showed that 8.4% of Australians had been exposed to at least one natural disaster and 4.8% to at least one man-made disaster in their lifetime. The mean lifetime frequency of natural disaster exposure was 0.2 in the total population (and 2.7 among those exposed to natural disasters). By contrast, the mean lifetime frequency of man-made disaster exposure was 0.4 in the total population (and 7.7 among those

exposed to man-made disasters). Among those exposed to natural disasters, 67.5% had experienced one and 32.5% had experienced two or more natural disasters. Of those exposed to man-made disasters, 64.4% had experienced one and 35.6% had experienced two or more man-made disasters.

Significant differences in the lifetime prevalence of natural disaster exposure based on chi-square analysis (Table 1) were noted for various population subgroups in terms of age, gender, country of birth, marital status, and qualification ($p < .05$). The same demographic variables also accounted for significant differences in the prevalence of man-made disaster exposure ($p < .05$).

Lifetime Prevalence and Risk of Suicidality Associated With Disaster Exposure

Table 2 outlines population estimates of the lifetime prevalence and risk of suicidal thoughts, plans, and attempts associated with varying types and levels of disaster exposure. The lifetime prevalence of suicidal thoughts, plans, and attempts was 16.3%, 4.9%, and 4.6%, respectively, for those exposed to natural disaster (contrasting with 13%, 3.9%, and 3.1% for those not exposed). Respective lifetime suicidality prevalence estimates for those exposed to man-made disaster were 20.3%, 6.4%, and 6.9% (compared with 12.9%, 3.8%, and 3.1% for those not exposed). The lifetime prevalence of suicidal behavior tended to be higher among groups with greater levels of disaster exposure and also among those exposed to man-made versus natural disaster.

Univariate logistic regression analyses, which examined the associations of disaster exposure type and level with suicidality risk (Table 2), showed that only man-made disaster exposure was associated with a significantly greater lifetime risk of suicidal thoughts (OR = 1.72, 95% CI = [1.11, 2.67], $p = .016$), plans (OR = 1.71, 95% CI = [1.04, 2.83], $p = .036$), and attempts (OR = 2.34, 95% CI = [1.17, 4.70], $p = .017$). Level of disaster exposure was associated with an increased lifetime risk of suicide attempts only for those exposed to either two or more natural (OR = 2.83, 95% CI = [1.24, 6.44], $p = .014$) or man-made (OR = 3.82, 95% CI = [1.22, 11.98], $p = .022$) disasters, with the latter group also more likely to have suicide plans (OR = 2.75, 95% CI = [1.40, 5.38], $p = .004$).

[TABLE 1][TABLE 2]

Multivariate logistic regression analyses were conducted to examine the association of disaster exposure type and lifetime risk of suicidality (Table 3, Model 1). After controlling for sociodemographic variables, natural and man-made disaster exposure, and exposure to any other potentially traumatic event, results indicated that only those exposed to man-made disaster were at significantly greater risk of making a suicide attempt (AOR = 2.25, 95% CI = [1.15, 4.40], $p = .019$). Natural disaster exposure did not appear to result in significant changes to lifetime risk of suicidality.

Multivariate logistic regression analyses were conducted to examine the association of repeated disaster exposure and lifetime suicidality risk (Table 4, Model 2). After controlling for demographic variables, respective levels of natural and man-made disaster exposure, and exposure to any other potentially traumatic event, results showed that those exposed to two or more natural (AOR = 2.21, 95% CI = [1.04, 4.71], $p = .039$) or man-made (AOR = 3.40, 95% CI = [1.20, 9.58], $p = .022$) disasters were at significantly greater lifetime risk of making a suicide attempt, with the latter group also being more likely to have made suicide plans (AOR = 2.33, 95% CI = [1.17, 4.64], $p = .017$). Exposure to a single natural or man-made disaster did not result in significant changes to lifetime suicidality risk.

[TABLE 3][TABLE 4]

Model 2 was subsequently amended to account for varying levels of exposure to "any other traumatic event" (by using a categorical instead of a dichotomous predictor variable, coded as exposure to 0, 1 or "2 or more" other traumatic events, irrespective of natural or man-made disaster exposure). Subsequent regression results indicated that multiple man-made exposure (AOR = 2.78, 95% CI = [1.01, 7.63] p = .047) but not multiple natural disaster exposure (AOR = 2.06, 95% CI = [0.97, 4.36] p = .058) was associated with an increased risk of suicide attempts. Previous findings on the heightened risk of suicide plans in multiple man-made disaster contexts were no longer significant (AOR = 1.88, 95% CI = [0.96, 3.66] p = .064).

Additional analyses of survey data explored the likelihood of the presence of other risk factors for suicidality (i.e., any lifetime *DSM*-IV mental disorder, without hierarchy; any lifetime *DSM*-IV affective disorder, without hierarchy; any lifetime *DSM*-IV substance use disorder, without hierarchy; lifetime *DSM*-IV alcohol use disorder; lifetime *DSM*-IV posttraumatic stress disorder; and lifetime exposure to "any other potentially traumatic event") in those exposed to 1 or "2 or more" disasters. These univariate analyses showed no statistically significant differences in the likelihood of these risk factors between groups exposed to 1 and "2 or more" (natural or man-made) disasters (p > .05). This indicates that cumulative exposure to multiple disasters (compared to single disaster exposure) was not associated with significant increases in the likelihood of these conditions (Reifels, Mills, Dückers, & O'Donnell, 2017). Nevertheless, cumulative natural (but not man-made) disaster exposure was associated with a near significant increase in the likelihood of exposure to "any other potentially traumatic event" (OR = 2.00, 95% CI = [0.99, 4.05], p = .055), thus highlighting exposure to other traumatic events as a potential driver of increased suicidality risk in natural disaster contexts. This latter finding was confirmed by multivariate regression analysis of general suicidality risk in the Australian population (Table 4, Model 2), which, in controlling for this particular and other mentioned variables, indicated a significantly increased lifetime risk of suicidal thoughts (AOR = 3.73, 95% CI = [2.75, 5.06], p = .000), plans (AOR = 8.29, 95% CI = [4.77, 14.42], p = .000), and attempts (AOR = 5.41, 95% CI = [1.57, 18.64], p = .008) for those who had experienced "any other potentially traumatic event" versus those who had not. Finally, we tested our Model 2 outcomes for possible effect modification in terms of the interactions of labor force status, relative socioeconomic disadvantage, and household location, with varying levels of exposure to natural or man-made disaster for each of the outcomes. No significant interaction effects were found in any of the 18 models that we tested.

DISCUSSION

Our study findings establish the differential suicidality risk associated with natural and man-made disaster exposure in a nationally representative population sample and highlight the critical role of repeat exposure across distinct disaster types. Only cumulative exposure to multiple natural disasters was associated with an increased lifetime suicidality risk (of making a suicide attempt), while cumulative exposure to multiple manmade disasters was associated with an even greater lifetime risk of suicidal behavior (in terms of suicide plans and attempts).

These national-level findings partly corroborate existing insights from a crossnational study of other world mental health survey countries (Stein et al., 2010), which had indicated an elevated risk of suicidal ideation and attempts following man-made disaster exposure (with respective reported ORs of 1.3 and AORs of 1.4). Yet, despite underpinning differences in study methodology and samples considered, our study also extends previous research insights by explicitly examining the role of multiple exposure to specific disaster types (whereas previous research has tended to either subsume disaster exposure within broader traumatic event categories or has not differentiated single disaster exposure from multiple disaster exposures). Our findings regarding the heightened risk of suicidal behavior in multiple natural disaster contexts further concur with insights from an earlier U.S. study (Krug et al., 1999), which noted a 15% increase in two-year postdisaster suicide rates in counties exposed to two natural disasters (compared with nonsignificant changes observed in counties exposed to one such event).

Taken together, these findings extend our understanding of the relatively greater potency of man-made (versus natural) disasters to produce adverse mental health outcomes (Bromet et al., 2017; Norris & Elrod, 2006) in terms of the associated decreased will to live. They also shed further light on the differential (and hitherto unclear) relationship of natural disaster exposure and human suicidality. Crucially, these findings suggest that exposure to a single natural disaster alone may not necessarily increase lifetime suicidality risk. However, repeat exposure to natural (or man-made) disasters significantly increases the risk of suicidal behaviors.

While individual mental health outcomes following repeat disaster exposure vary, these population-level findings would speak against the protective "inoculation effect" that initial disaster involvement could be hypothesized to have on suicidality during subsequent disasters (Knight, Gatz, Heller, & Bengtson, 2000; Norris & Murrell, 1988; Shrira, Palgi, Hamama-Raz, Goodwin, & Ben-Ezra, 2014). On the contrary, it would appear that repeat exposure to natural or man-made disasters significantly increases the risk of suicidality in the population. Similarly, care should be taken not to interpret the neutral risk of single natural disaster exposure as "immunizing" against individual suicidality risk, as natural disaster events can differ dramatically in terms of intensity and scope, as well as individual and societal impacts. Both specific individual and broader risk and protective factors need to be taken into consideration when determining who is at risk of suicidality in the wake of disaster (Bonanno, Brewin, Kaniasty, & La Greca, 2010; Borges et al., 2010; Johnston et al., 2009).

Universally greater odds of lifetime suicidality risk associated with man-made disaster exposure identified in all regression models concur with the findings from a recent factor analysis, which examined exposure to the full range of traumatic events across world mental health survey countries (Benjet et al., 2016). This analysis indicated that while natural disasters were not only categorized under and found to primarily load on traumatic events in the "accident/injuries" cluster (which are typically seen as less intentional, and therefore also less susceptible to conspiracy), manmade disasters (classified under "other traumas") loaded on two principal factor clusters, namely "accident/injuries" and "collective violence." These factor loadings simultaneously suggest that repeat disaster exposure as a driver of increased suicidality risk in the current context may be linked to other types of traumatic event exposure. Earlier studies based on world mental health survey data confirmed that exposure to different types of traumatic events is accompanied by a higher prevalence of different types of mental disorders, in particular of mood and posttraumatic stress disorders

(Dückers, Alisic, & Brewin, 2016; Dückers & Brewin, 2016). Nevertheless, our study findings regarding the effects of repeat disaster exposure held true even when controlling for the likelihood of exposure to any other type of traumatic event and for the presence or absence of these commonly associated lifetime mental disorders. This result suggests that the theoretical distinction between man-made and natural disasters, which appeared empirically distinctive in the factor analysis by Benjet and colleagues (2016), is an important explanatory factor for variation in suicidality. In view of Hobfoll's (1989) conservation of resources theory of traumatic stress, it is further conceivable that recurrent setbacks and multiple adversities encountered in repeat disaster contexts, man-made more than natural, can threaten to deplete vital existing resources and may therefore be experienced by some individuals as particularly demoralizing, which in turn may lead them to give up and to plan or even attempt suicide.

Study Strengths and Limitations

Our findings need to be interpreted in light of several study strengths and limitations. Study strengths included the use of data from a nationally representative population survey, which enabled extrapolation from sample characteristics to broader population parameters. The study focussed on nonfatal suicidal behavior (not on suicide). While accounting for varied sociodemographic variables and exposure to other traumatic events, the study did not control for other contributing factors of suicidality (such as economic conditions). The NSMHWB involved cross-sectional retrospective survey data and a relatively crude disaster exposure measure, which classified disaster events by primary source or agent and which did not permit differentiating more specific disaster characteristics such as type, scope, intensity, location, or degree of individual disaster exposure. Unlike expert-based classification of disaster type on the basis of scientific typologies, lay classification of natural or man-made disaster type is inevitably more likely to be guided by subjective interpretations and by the material content of interview questions. The 2007 NSMHWB data did not reflect more recent major Australian disasters, such as the 2009 Black Saturday bushfires in Victoria or the 2010–2011 Queensland floods. Despite the CIDI's established sound psychometric properties and strong concordance with standardized clinical assessments (Andrews & Peters, 1998; Haro et al., 2006), the sensitivity and specificity of its suicidality module remain unknown. While cross-sectional survey data enabled the examination of key variable associations at population level, our analysis did not permit definitive causal or temporal inferences in regard to the direction of effects or the chronology of events over time. Resulting lifetime suicidality estimates are therefore likely to reflect inflated estimates of the true prevalence of postdisaster suicidality.

Implications

Key study findings regarding the distinctive empirical relationship of multiple disaster exposure and suicidality risk may benefit from further replication in nationally representative population samples and prospective cohort studies. Future research should therefore adopt appropriate measures and sufficiently large time frames to capture the degree and level of exposure to distinct disaster types while controlling for other types of traumatic event exposure. Future studies may further benefit from exploring the extent to which exposure to "other traumatic events" mediates (or moderates) the relationship of disaster exposure and suicidality.

Pursuant to confirmation of this distinctive relationship, our findings have practical implications for disaster mental health. Because nonfatal suicidal behaviors are among the strongest predictors of suicide (Nock et al., 2008), our study findings may have significant implications for population groups in disaster-prone areas and others at elevated risk of repeat disaster exposure. This study highlights the need for an all-hazards approach to disaster mental health response planning and population health surveillance that incorporates explicit provisions for screening for suicidality and associated risk factors, which importantly include (but are not limited to) previous or repeat disaster exposure. This approach can facilitate the identification of high-risk individuals in disaster-affected populations and optimize the targeting of appropriate mental health support. In ascertaining heightened levels of suicidality risk, special consideration should further be given to exposure to a range of other traumatic life events, which, although not necessarily always directly linked to disasters, are also increasingly likely to occur during the disaster impact and often-prolonged disaster recovery phases (Garfin, Silver, Ugalde, Linn, & Inostroza, 2014; Kessler, McLaughlin, Koenen, Petukhova, & Hill, 2012; Lock et al., 2012). Postdisaster psychosocial support should,
therefore, explicitly consider suicidality in disaster contexts to incorporate effective strategies to address suicide thoughts, plans, and attempts, especially in those contexts where repeat disaster exposure and exposure to range of other traumatic events are evident or highly likely. Previous research on the temporal aspects of disaster suicidality further indicates that it is critical not to limit this attention to the immediate disaster aftermath, as increases in population suicidality are often delayed and perhaps even more likely to occur further down the track (Kõlves et al., 2013).
Apart from increasing attention to suicidality in postdisaster psychosocial support strategies, it is vital that efforts be made to address the underpinning reasons that give rise to increasing disaster exposure and additional or prolonged suicidal stressors in disaster contexts (such as via effective rebuilding, recovery, and insurance schemes, which can restore livelihoods and ameliorate property damage). Globally increasing disaster risks, including projected increases in frequency and intensity of extreme climatic events (Intergovernmental Panel on Climate Change, 2012) and prevalence of man-made disasters (Coleman, 2006), further highlight the need for effective and more proactive approaches to disaster risk management, which can preemptively reduce the risk of population exposure and existing vulnerability to disasters, and thereby mitigate adverse disaster impacts and health consequences (Aitsi-Selmi & Murray, 2016). Our study findings clearly highlight the likely benefits of such approach to disaster risk reduction for population mental health.

CONCLUSION

Study findings extend existing insights into the relatively greater potency of manmade (versus natural) disasters to produce adverse mental health consequences in terms of the associated increased risk of suicidality and establish the critical role of repeat disaster exposure across distinct disaster types. Repeat (but not single) exposure to natural or man-made disasters was found to be associated with an increased risk of suicidal behavior in the population. Suicidality may, therefore, warrant increasing attention in psychosocial recovery schemes, particularly in the context of disaster-prone areas and for population groups at elevated risk of repeat disaster exposure.

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TABLES

TABLE 1. Lifetime Prevalence and Mean Frequency of Disaster Exposure in the Australian Population

	Sample Count	ND Exposed	MD Exposed	Mean Freq. ND Exposure	Mean Freq. MD Exposure
	(Unweighted)	(Pop)[a]	(Pop)[a]	(ND Exposed)[a]	(MD Exposed)[a]
Population Group	n	%	%	μ	μ
Age		***	**		
16–29	2,031	5.06	2.75	4.55	6.60
30–49	3,000	9.44	4.79	2.49	3.98
50–64	1,905	9.76	6.00	2.25	10.44
≥65	1,905	9.40	6.38	2.06	12.13
Gender		**	***		
Male	4,027	9.77	6.74	2.65	9.18
Female	4,814	7.14	2.93	2.66	4.58
Country of birth		*	*		
Australia	6,530	7.52	4.28	2.57	8.79
Main English speakingb	1,032	9.64	7.10	3.29	5.10
Other	1,279	11.86	5.70	2.52	5.87
Marital status		***	**		
Never married	2,894	6.30	3.26	3.85	7.77
Previously married	1,945	9.33	6.85	2.46	3.99
Married	4,002	9.52	5.22	2.22	9.04
Non-school qualificationc		***	**		
No	3,917	6.44	3.86	1.63	8.17
Yes	4,924	10.10	5.61	3.20	7.46
Labor force status					
Employed	5,499	8.12	4.82	3.15	5.25
Unemployed	216	7.91	3.35	2.59	1.23
Not in labor force	3,126	9.14	4.94	1.76	12.92
Index of relative socioeconomic					
1st Quintile	1,529	9.46	5.38	1.78	6.68
2nd Quintile	1,756	8.86	5.35	4.85	10.67
3rd Quintile	1,793	8.10	4.06	2.40	9.95
4th Quintile	1,854	8.22	5.72	2.31	4.94
5th Quintile	1,909	7.88	3.80	2.00	7.81
Locatione					
Major urban	5,683	8.22	4.53	1.94	8.35
Other urban	2,054	9.02	5.28	3.21	6.18
Other	1,104	8.67	5.55	5.32	7.67
Total	8,841	8.44	4.82	2.66	7.72

Note. ND = natural disaster; MD = man-made disaster; pop = population.
aWeighted population estimates.
bMain English-speaking countries include Canada, Ireland, New Zealand, South Africa, the United Kingdom, and the United States.
cHolding a qualification or degree above school level.

dThe Index of Relative Socioeconomic Disadvantage (IRSD) is derived from ABS census data and forms part of the Socio-Economic Indexes for Areas (SEIFA), 2006; 1st quintile = most disadvantaged, 5th quintile = least disadvantaged.
eHousehold location based on classification of census collection districts, with "major urban" (> 100,000 population), "other urban" (1,000 to 99,999), and "other" incorporating "bounded localities" (200 to 999) and the "rural balance."
Significance level (based on chi-square analysis): *p < 0.05; **p < 0.01; ***p < 0.001.

TABLE 2. Lifetime Suicidality Prevalence and Risk Associated With Disaster Exposure (Univariate Binary Logistic Regression Analyses)

	Lifetime Thoughts[a]			Lifetime Plans[a]			Lifetime Attempts[a]		
Predictor	%	OR	95% CI	%	OR	95% CI	%	OR	95% CI
ND exposure									
No	12.97	1.00		3.86	1.00		3.13	1.00	
Yes	16.34	1.31	[0.95, 1.81]	4.91	1.29	[0.73, 2.28]	4.59	1.49	[0.79, 2.79]
0	12.97	1.00		3.86	1.00		3.13	1.00	
1	15.49	1.23	[0.81, 1.87]	3.72	0.96	[0.47, 1.98]	2.79	0.89	[0.39, 2.03]
2 or more	18.22	1.50	[0.90, 2.50]	7.42	1.99	[0.86, 4.63]	8.36	2.83*	[1.24, 6.44]
MD exposure									
No	12.89	1.00		3.83	1.00		3.06	1.00	
Yes	20.31	1.72*	[1.11, 2.67]	6.38	1.71*	[1.04, 2.83]	6.89	2.34*	[1.17, 4.70]
0	12.89	1.00		3.83	1.00		3.06	1.00	
1	21.84	1.89*	[1.11, 3.21]	4.78	1.26	[0.69, 2.30]	5.12	1.71	[0.82, 3.54]
2 or more	18.67	1.55	[0.78, 3.08]	9.85	2.75**	[1.40, 5.38]	10.77	3.82*	[1.22, 11.98]

Note. ND = natural disaster; MD = man-made disaster; OR = odds ratio; CI = confidence interval.
[a]Weighted population estimates. Significance level: *p < 0.05; **p < 0.01

TABLE 3. Predictors of Lifetime Suicidality Risk in Australia (Multivariate Binary Logistic Regression—Model 1)

	Lifetime Thoughts[a]		Lifetime Plans[a]		Lifetime Attempts[a]	
Predictor	AOR	95% CI	AOR	95% CI	AOR	95% CI
ND exposure						
No	1.00		1.00		1.00	
Yes	1.15	[0.82, 1.60]	1.15	[0.62, 2.14]	1.26	[0.63, 2.54]
MD exposure						
No	1.00		1.00		1.00	
Yes	1.54	[0.99, 2.39]	1.54	[0.93, 2.55]	2.25*	[1.15, 4.40]

Note. ND = natural disaster; MD = man-made disaster; AOR = adjusted odds ratio; CI = confidence interval.
aWeighted population estimates. Regressions controlled for age, gender, country of birth, marital status, qualification, labor force status, relative socioeconomic disadvantage, household location, natural and man-made disaster exposure, exposure to any other traumatic event (defined as lifetime exposure to at least one of 27 "other" potentially traumatic events that are routinely assessed within the WMH-CIDI 3.0, irrespective of MD and ND exposure). A collinearity test, which examined the conditioning of the above matrix of predictors in the sample (using STATA "coldiag" command), produced a matrix condition number = 10.87, which is well below the suggested cutoff score of "30 or larger" that would otherwise be indicative of collinearity problems (Belsley, Kuh, & Welsch, 1980).
Significance level: *p < 0.05.

TABLE 4. Predictors of Lifetime Suicidality Risk in Australia (Multivariate Binary Logistic Regression—Model 2)

	Lifetime Thoughts[a]		Lifetime Plans[a]		Lifetime Attempts[a]	
Predictor	AOR	95% CI	AOR	95% CI	AOR	95% CI
ND exposure level						
0	1.00		1.00		1.00	
1	1.12	[0.73, 1.71]	0.89	[0.40, 1.95]	0.75	[0.27, 2.04]
2 or more	1.26	[0.76, 2.09]	1.56	[0.62, 3.92]	2.21*	[1.04, 4.71]
MD exposure level						
0	1.00		1.00		1.00	
1	1.73	[0.96, 3.09]	1.14	[0.62, 2.11]	1.62	[0.77, 3.40]
2 or more	1.29	[0.67, 2.47]	2.33*	[1.17, 4.64]	3.40*	[1.20, 9.58]

Note. ND = natural disaster; MD = man-made disaster; AOR = adjusted odds ratio; CI = confidence interval.
aWeighted population estimates. Regressions controlled for age, gender, country of birth, marital status, qualification, labor force status, relative socioeconomic disadvantage, household location, natural and man-made disaster exposure levels, and exposure to any other traumatic event (defined as lifetime exposure to at least one of 27 "other" potentially traumatic events that are routinely assessed within the WMH-CIDI 3.0, irrespective of MD and ND exposure). A collinearity test, which examined the conditioning of the above matrix of predictors in the sample (using STATA "coldiag" command) produced Matrix condition number = 10.85, which is well below the suggested cutoff score of "30 or larger" that would otherwise be indicative of collinearity problems (Belsley et al., 1980).
Significance level: *p < 0.05.